Program Management and Interactive Management Decision Systems

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Introduction

The issues raised by Galbraith in his paper provide the context for this discussion of the impact of information technology on the program management task. The management of large technological programs was chosen by him for three reasons; its importance, its general pervasiveness in all areas of human endeavor, and its implications for organizational design. The material discussed in this paper is particularly applicable to this specific problem. Large technological programs are sensitive to information lag because of the integration of specialists and the other issues that Galbraith raises. Changes in control concepts and the tools available for planning and control, particularly computer technology, can affect this information lag, and other aspects of the program management function.

However the Management Decision System (MDS) that is discussed in this paper is not only useful in the program management context, it is increasingly applicable across the management function. Many industries are faced with a continuing, and increasingly rapid, change in technology. Their own production processes, materials and new products often involve a higher level of technological sophistication than in previous years. This not only increases the communication problems between functions but can even mean that the implications of a decision within a function are counter-intuitive for the managers involved. This change in technology

coupled with the increasingly short life-cycle of products in some industries produces many of the same problems for managers as one sees in the large technological programs as typified by those in the Aerospace business.

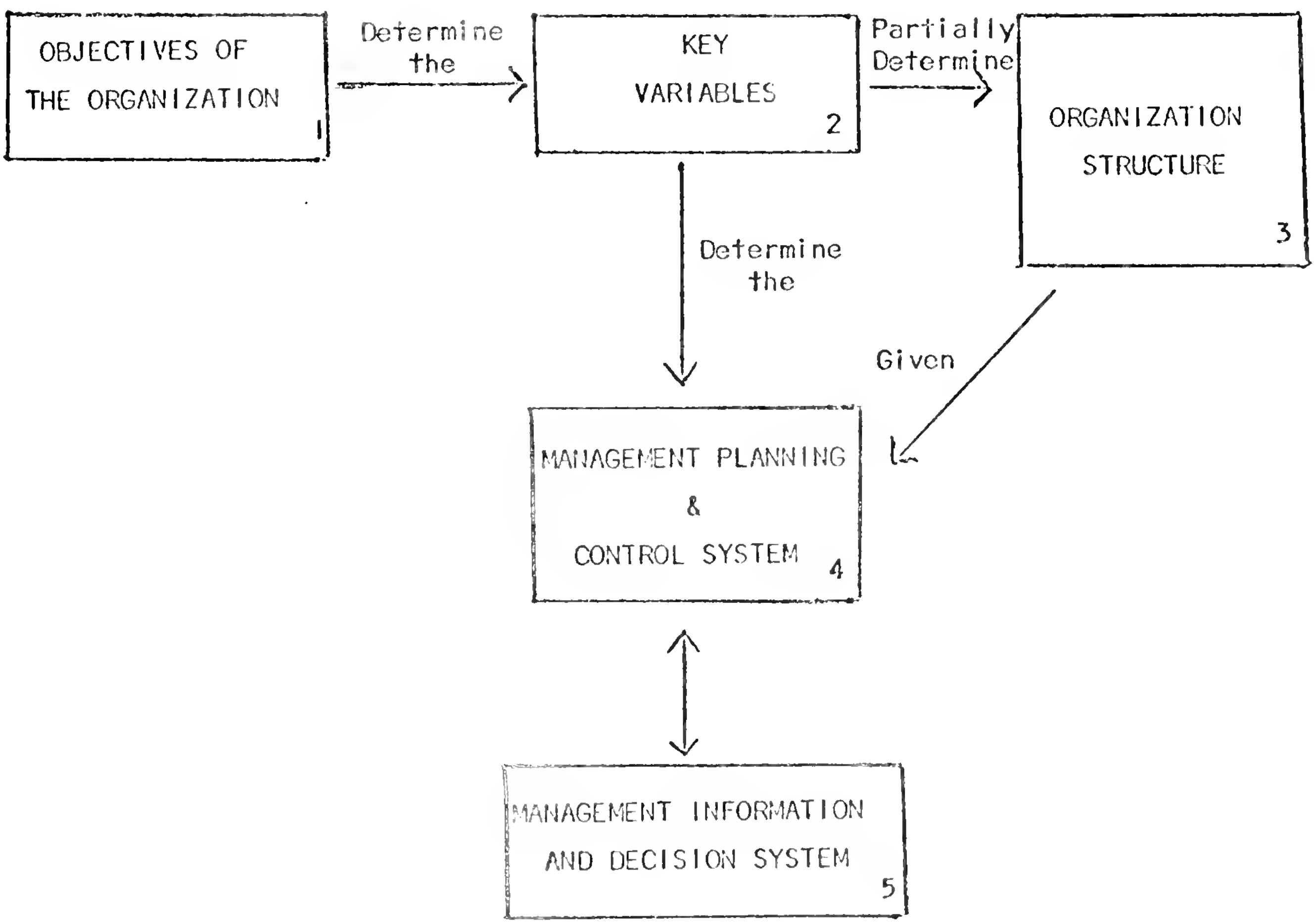
Thus many companies with products which have a high technological content have management decisions which are getting more complex as the concepts and production processes keep changing. This results in the familiar problem of marketing people being unable to communicate properly with the production or purchasing people and so forth. Similarly many conglomerates are unable to communicate effectively between groups. The concepts, technology and language in one group are not fully understood by the other. With the continuous movement of managers, the short life-cycle of the products and the changing technology, there is not enough time to slowly work out of the communication problem, and evolve a common set of informal decision models. In a stable and slow moving environment each manager involved can build for himself an internal 'model' of his environment and the way it works. As the pace picks up these old models become invalid and managers do not have time to construct new ones. It is in such an environment that a MDS can be useful and of course program management almost invariably involves such an environment.

We would like to be able to use the new technology available in the information systems field to increase the quantity and quality of relevant information to the mangers involved in the program management function. * Computers can be used very effectively for these high-level line managers, but not in traditional ways, such as historical reports based on traditional accounting data from a batch processing computer system. Typical management information systems bui't around batch processing computers are most useful for structured problems. That is problems that have well defined methods

of solutions, and that are predictable. The program management function is largely unstructured and requires a different kind of support if the organization is to buy slack resources with the use of information. To do this we propose the use of a Management Decision System, the components and implications of which are raised below.

To provide some context for this paper the place of a MDS in the overall control process can be thought of as follows:

Figure 1



The objectives (Box number 1) of the organization are a prerequisite for all that follows. The critical process of determining these is discussed briefly below, but not in the depth it deserves.

The objectives determine the key variables (2) that are to be used to monitor progress toward the objectives. These key variables and the objectives help to determine the organizational structure (3) to the extent it is possible to alter it. Similarly, given the organizational components which cannot be altered, this helps to determine the nature of some of the key variables. The management control system (4) in turn is designed to monitor the key variables, given the organization structure. Thus the management control system should be dependent on the three preceding constraints.

The final components (5), the management information system and the management decision system should be designed to support the management planning and control process. We discuss below the recent changes in technology as they affect the management information and decision systems.

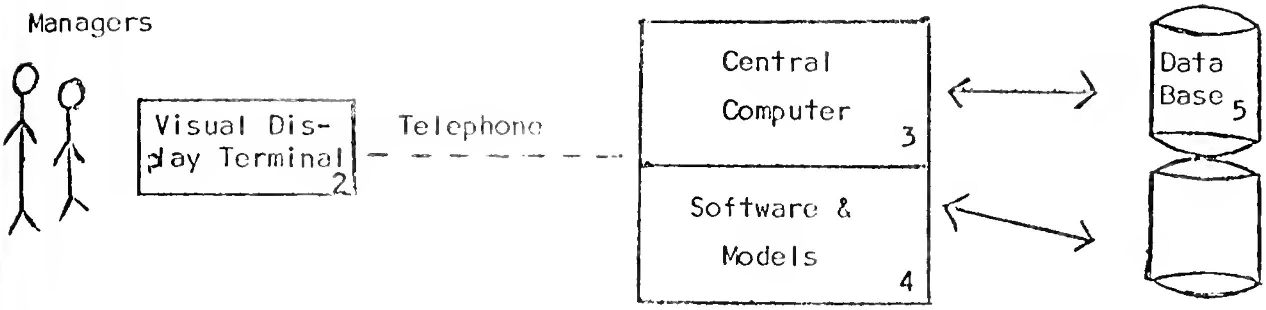
Components of a Management Decision System

The components of a Management Decision System have been discussed in some detail elsewhere[1]. Figure 2 provides a representation of the major elements.

The managers (1) and their problem are provided with access through an interactive visual display terminal to the central computer, models and data-base of the system. For complex unstructured problems the terminals (2) should be visual displays capable of drawing graphs as well as the normal character set. Question of Acces.

[1] See M.S. S. Morton, Management Decision Systems, Harvard Business School Division of Research (forthcoming).

Figure 2



The central computer (3) should support multiple users on a remote basis but need not be time-shared. The software and models (4) are the most critical element and should be designed to support the manager in his decision process[2]. The software has to be designed to support the manager on his own terms, to provide flexible and simple access to the data and models. This is a complex and non-trivial task but our experiments[3] have shown that it can be done effectively.

The last component, the Data-Base (5), contains the on-line data necessary to support the models and the managers' decision process. There is one important clarification to be made. The on-line characteristic of the data provides immediate response to a question or request for computation by the manager. This is to be carefully differentiated from having the data maintained in real-time. In many applications, including some program management applications, the data does not have to be absolutely current.

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[2] Morton, M.S.S., "Development and Evaluation of an Interactive Display System for Management Planning" in Management Information Systems: Progress and Perspectives, Carnegie-Mellon University (forthcoming).

[3] Morton, M.S.S., "Computer-Driven Visual Display Devices--Their Impact on the Management Decision-Making Process", Doctoral Thesis, Harvard Business School, June 1967.

Often data that is several days, or even a week old, is adequate. However immediate response during a problem-solving session is important if the decision process is to proceed at speeds comparable to man's natural thought process. This differentiation between the currency of the data-base and the response time of the system is an important one to have clearly in mind.

Our experiments have shown that the key features of such a management decision system when used in an unstructured management situation are:

1. Simple to operate, so that an executive with no computer knowledge and a busy schedule can use it comfortably.
2. Interactive, so the system responds readily to user requests, and does not hinder the user's natural problem-solving process.
3. General purpose, in order to be applicable to many parts of the business.
4. Modular, to absorb changes in the software and allow for the addition of different forms of data.
5. Hardware independent, to allow change of terminals with advancing technology.

The use of interactive decision systems, such as the one described above has been limited thus far. This seems to have been due to at least three factors:

1. The first of these has to do with our concepts and understanding of management planning and control. Such systems require the user to have thought through his decision processes, identified the most critical decisions and analyzed them carefully to identify the kind of decision support that is necessary. Only certain kinds of decisions can justify the sort of power available with an MDS. This analysis is a difficult step to take and has very often failed. One can find experiments which have been run with displays which provided the manager with access to information for which he had no real need--or in other cases, information which could have been

provided adequately by a manual or Batch system. The failure of the display system has then been attributed to the inappropriateness of interactive display systems for managers, whereas in fact the failure was in selection of the problem, the quality of the analysis or the implementation strategy.

2. The second major factor in the failure of more widespread use has been with the cost, and lack of familiarity, of the hardware and software required. Costs have been high, but are rapidly dropping. Appropriate graphical interactive displays cost $150,000 two years ago. An equivalent system is now $60,000 and some experts expect costs to fall by 50% in the next two years. Already for example a roughly comparable system, althought with slightly less power, based on the storage tube technology is available for $15,000. Software strategy and development of general systems has been slow as users feel their way. This is changing as we pass through the first working systems and companies develop their second generation of applications. Hardware, software and our concepts have all reached the point where we can do something effective. It remains for users to try.

cost

3. The third reason is closely related to the second. Costs are not a problem if the investment can be shown to have a good return. Similarly high start-up costs can be mitigated by using the experience, or the actual programs, on subsequent applications. For both of these reasons it becomes important to have good measures of the effectiveness of any application. Unfortunately research in this field is made difficult by the problems inherent in measuring the impact of any new system on a manager's decision making skills. The

Intangibles are many, and skill is needed in research design if significant evidence is to be collected to show the correct cost/benefit picture for such systems.

Impact of a Management Decision System

Although this technology is new there have been at least two successful installations of such systems in a management setting and several less successful. The "successful" ones had a significant impact on the decision process. The larger of these projects resulted initially from an academic experiment but has had continued line manager use for two years since the initial experiments, as well as expansion to other problem types. The less successful applications that the author has examined all resulted in a net gain in user knowledge but did not have the intended effect on the manager's decision process. Evidence from all these sources suggests five clear kinds of impact on management decision-making and the related information flows. Each of these is discussed in general terms below, where there is relevant specific evidence, this has been cited, although the Bibliography contains the original sources of support. Some of the support for these issues is of a much more speculative nature, derived by osmosis from working with such systems. The major thrust of these comments seems to be well supported from our experimental work. However specific findings should all be regarded as tentative because we do not have enough experimental evidence to justify each aspect of the major points.

The evidence collected thus far establishes beyond any doubt that such systems can be built with the current technology. Line and staff managers can use such systems for certain problems and find them to be capable of supporting their decision process. The net effect can improve the quality of staff work in analysis and can have an impact on the decisions reached by line managers, particularly Program Managers.

The issues that remain to be established in detail are to clarify the types of problems for which such systems are useful, to understand the analysis, design and implementation phases and to improve on the measurement process.

There is no doubt that not all managers will have problems that necessitate their personally using the system. The major issue however is whether the system will change the decision process and the quality of the final outcome.

One problem for which the MDS is eminently suited is that of program management. This problem type is often complex, unstructured, involves large quantities of data, uses models and requires inputs of managerial judgment. These five problem characteristics are those for which a MDS can be of considerable help. The computer has a relative advantage in handling the models and the high data volume. The terminal allows the manager to input his judgement and to provide the kind of structure he wants in the otherwise unstructured situation. When a MDS is used for problems of this type our experiments have shown the following five major kinds of impact:

I. <u>Clarification of Issues</u>

We have made the assertion that the MDS is most useful for unstructured problems and that the program management function has many significant unstructured components. This lack of structure creates two difficulties. The first of these is the difficulty of finding the problem. In a poorly understood system many signals from the control system will be caused by symptoms of the problem--not the real underlying cause. Probing and searching through the data by a competent manager can often provide enough clarification to define the problem. *

The second difficulty caused by lack of structure is the multi-dimensionality that is almost inevitably involved. Complex programs have many significant dimensions (time, cost, risk exposure, etc.) along which progress can be measured. Any particular reporting structure can only present a few variables at a time, and often these have had to be prespecified well ahead of time. With the MDS one can easily look at the variables that are relevant at a particular moment in time--and along any dimensions that seem appropriate.

To be able to search for problems and deal with the multi-dimensionality involved implies that two key features are present. The first of these is an appropriate data-base, which in turn poses three requirements:

a) The scope of the available information clearly has to be relevant to the decision being made in regard to the program. This implies some prior analysis so the right quantity and level of data can be maintained on an ongoing basis.

b) The structure of the data-base is also important. To retrieve data in a flexible and rapid way involves questions of file design that are complex. For example, a hierarchical data-structure serves very effectively if the general thrust of data needs are known, while an associative list-structured file provides greater flexibility at an increased cost in retrieval time and size of storage required.

c) The cost accounting and other financial data have to be collected and maintained at a level fine enough so that they can be re-aggregated in whatever way is called for by the user. This implies some care with the definition of costs and cost centers.

The second feature that must be present to allow the user to search for problems and deal with the multi-dimensional aspects, is the graphical capability of the MDS. The communication inherent in graphical presentation of data is much greater than tabular data. Imaginative use of graphs, with, for example, several variables plotted on each of four sets of axis, can greatly increase the meaning of a given set of data. In browsing through the data to find, or substantiate a problem, or to test the implications of several possible solutions, it becomes important to have a technique that provides high information content. In many decision situations more information is conveyed in a shorter time with graphs as opposed to tables of data. Also, in some situations it can be effective to use three dimensional surfaces or dynamic displays of variables moving over time in some appropriately defined space. These, and similar techniques, can make a significant impact on the level of understanding a manager can have of a situation with which he is not directly familiar.

Related to this increase in useful information is the potential that exists in the 'live' screen the manager is viewing. The computer 'draws' the information that the manager is using, hence if it is 'touched' with the light-pen the system knows exactly what is being pointed at, and can respond accordingly. With appropriate programming it is possible to provide flexibility yet leave the manager with simple commands that use his terminology and simply require him to point at the screen.

Such systems have been built and successfully tested with line managers. Systems design and software architecture is a problem, but one that can be solved. Using such systems managers are able to work their way through their problem in whatever way makes sense to them. They can examine the data along any dimension that appeals to them and by so doing

can build up a precise view of the problem. This clarification process may involve filtering the data through models, sensitivity analysis in testing the impact of alternative strategies and so forth. With an appropriate set of models and presentation formats it is possible to clarify the problem and hence move effectively toward a solution.

2. Exploration of Alternatives

A second significant impact of an MDS is the ability to explore alternative strategies in the solution of a problem. Planning and control, particularly in a program environment, obviously does not just involve a clear view of historical performance, it also involves adjustments in current activities to achieve some desired future performance.

Given the clarified and common position achieved with the MDS in the previous step of the process, what is now required is the next and more important ability to let the impact of various alternatives be seen over time. Having the manager suggest alternatives and having the system calculate the impact and present the results is a useful combination. The system can perform those tasks for which it is most suited, rapid computation and consistent access to large data files--while the manager can use his pattern recognition and judgmental skills.

Given a clear definition of a current problem one would like to assess the effectiveness of various strategies on the goals of the program. With the technology that has been available until recently this has been difficult. Batch computers, accounting systems and the data collection schemes have often been historically oriented. Particular planning tools, such as PERT and PERT/COST were devised to offset this historical bias and they have been a considerable improvement. These tools are awkward to use as they become large, and their viability as an active planning tool is corres-

pondingly reduced. It is often not easy to take a large network and test various alternatives in an interactive way. Similarly for control purposes if one wishes to examine data along criteria, or for time periods, other than those established in the system it is difficult, slow and expensive under batch systems.

The future is important in most decision situations and this implies more than just increasing information flow to buy slack. As Galbraith correctly points out in his paper, increasing the flow of relevant information will buy the organization some slack. This is the sort of activity we discussed in (1) above. Perhaps more significant is the slack the organization can buy by improving the planning process. Looking into the future and evaluating current trends and possible new strategies can successfully remove the crisis atmosphere of jumping from fire to fire.

An MDS can do this by allowing the manager to insert alternatives and test them. The manager can take one strategy, look at its implications over time along any relevant dimensions, then try some other strategy and contrast its implication in some formal way. Such systems have been built and tested[4] and found to work well. In the normal case they involve models and it is the power of these coupled with the ease with which managers can look forward in time that provides much of the benefit.

3. Managerial Use of Models

The above discussion focused on the importance of establishing the effectiveness of strategies over time and strategies that have been designed to solve a current problem. Clearly this means that explicit formal

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[4] Morton, M.S.S. and McCosh, A.M., "Terminal Costing for Better Decisions", Harvard Business Review, May-June 1968. (footnote continued on next page)

models are involved. An MDS implies that planning models are imbedded in the system. Such explicit inclusion of formal models differentiates the Management Decision System from a Management Information System. The inclusion of specific models to support a particular decision maker in solving certain aspects of his key problem involves a careful design and implementation process. One that is significantly different from the traditional approach to systems design that is inherent in many actual implementations of an MIS.

Models have had limited impact on line managers thus far. This has been because of technological limitations and our lack of understanding of where models can be effectively used. Only certain aspects of particular decisions lend themselves to economically viable modeling. With the technology discussed above and the insights gained from research into managerial use of models we are moving toward the creation of a cost/effective change in the planning and control systems available to managers.

In developing such an MDS it is important to work with a range of models. Starting with simple ones that apply only to a small part of the problem allows both the designers and the managers to learn. As the manager grows to understand the model, he develops the right degree of trust in its output. More importantly, he begins to see where additional changes can be made and starts to bring more reality into the model in those areas where he feels it will be of greatest benefit. This evolutionary design, with the decision-maker one of the most active in the change process is clearly desirable. The process by which it occurred in one experiment is traced briefly below.

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4 (cont.)

Ness, D.N., "Interactive Budgeting Models: An Example, " MIT Working Paper No. 345-68.

Morton, M.S.S. and Stephens, J., "The Impact of Interactive Visual Display Systems on the Management Planning Process", Proceedings of the IFIP Congress 68, Edinburgh, Scotland, August 1968. Also MIT Working Paper No. 356-68.

The three managers involved[5] were given access to exactly the same data as they used under the former, largely manual, decision process. The only explicit model involved was a batch run of an exponential forecasting model. The MDS offered them graphical presentation of various actual, planned and forecasted data which they could change as they saw fit. Initial response during the experimental period was very favorable. After six months of use of the system they were able to move from 5 full days of meetings on this problem process to about 1/2 day. The availability of some slack time, plus the way in which the system pointed up inconsistencies resulted in the managers beginning to be concerned with the quality of their own decision process. They began to make suggestions for changes in the system and before long were actively involved in the evolutionary development of their MDS.

After a further year of use and continued changes to the data-base and decision process we are now beginning to get some concern with the quality of the overall decision model they are using. They had been used to having an internalized informal model, with a set of ill-defined rules of thumb, which they used to identify problems and evaluate solutions. The significant feature offered to them by the MDS is access to their decision process. The managers were asked to be explicit about their decision rules - rules as to what they regarded as a problem situation and rules as to what constituted a 'good' solution. For many managers this is a difficult task. Their rules are often implicit not explicit, they have not been used to defining or discussing them. With such internalized and ambiguous rules it is clear that there must be occasions when inconsistent decisions are made as well as occasions when problems are not detected or 'better' solutions not found.

[5] Morton, M.S.S., Management Decision Systems, op. cit.

With the use of the MDS the managers develop solutions by using the light-pen on the display screen. The computer can be programmed to monitor this and maintain a trace of the actual displays used as well as the changes made. Similarly the conversations among the managers can be monitored by the use of a tape recorder.

After the decision process is over the displays and the recorder can be replayed and the entire process repeated. The analysts or the managers can repeat the whole session or parts over and over again if they wish. During this replay one can look for hidden, or implicit criteria and decision rules. Patterns are identified that can be tested on past sessions and the actual managers involved can react. By such an iterative process one can begin to develop explicit models of the decision process. These can be modified over time as the managers involved begin to see changes and inconsistencies in their now visible internal models.

This slow but continuous construction of decision models is a powerful process for several reasons. Perhaps the most significant is that it results in some transfer of a manager's talent to a form that is independent of him. If he should leave, retire or become unavailable for any reason then the organization has learned something from him. The next incumbent of that position has a base on which to build and can start his learning process from the accumulated and explicit 'wisdom' of his predecessors.

This process allows the construction of a set of built-in filters--simple decision models--which can provide the managers with a first level of intelligent support for their decision process. This capturing of decision rules, building algorithms and heuristics that support the process is a significant change in our traditional approach to M.I.S.

This is obviously an oversimplified view of the process. Different managers operate differently, the environment is constantly changing--both outside the company and inside. However our experiments have shown that such learning can take place and it can be a significant improvement over the currently intuitive process.

The inclusion of such decision models is one characteristic of an MDS. Also included should be access to any relevant planning models. A planning model in this context is one that supports the decision maker in his evaluation of alternative strategies in the future. PERT and other program management models are in this category. Their use and structure in the past has been largely geared to their use in a batch environment. There are at least two major changes to be made in looking at such techniques in the context of an MDS.

The first of these is the hierarchical structure that should exist in the model and the second the user oriented command structure to deal with the model. A large complex PERT network takes time to compute--often several hours on a large computer. The detail involved is sometimes necessary but more often a huge percentage of the calculations are identical to the previous iteration. A hierarchical structure will allow the user to work at the level of aggregation that is appropriate. This improves the response time and hence allows more alternatives to be tested by the manager in the same time period. Hierarchies may call for clever ways of collapsing greater detail into a more aggregate and smaller representation of the model. Research is underway in this field[6] and it seems clear that the use of aggregate models can lead to their interactive use by managers.

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[6] Crowston, W.B.S. and I rton, M.S.S. "The Design of Hierarchical Systems", Sloan School of Management Working Paper (forthcoming).

The second major change from the current use of planning models is the ease with which managers should be able to obtain the information they require. The aspects of the model that the user sees should be in his language and able to be used in a style that he finds comfortable. Flexible, powerful and simple access to the models and information in the system is an easy statement to make but a difficult one to implement well. However it is an important feature, and if not effectively implemented can block the benefits from the use of a MDS.

This third impact of the MDS then is based on the conclusion of formal models in the system. Models built by managers to help them find problems as well as those used for future planning.

4. Inclusion of Managerial Judgment

We have been discussing the use of a MDS in the context of the program management function, as one important instance of a complex unstructured series of decision situations. Unstructured at least in the sense of not knowing what constitutes a problem, or what represents a good solution. In such problems managerial judgment and intuition are an important ingredient in the decision process. Hence an effective solution couples these managerial talents with the system's capabilities for rapid retrieval, computation and consistency. The system can also help the manager be more consistent by allowing him to deal in a more structured way with the problem of uncertainty. Many companies do not make explicit their attitudes toward risk, and many program management techniques, such as PERT, do little to remedy this. Taking a rigorous approach (see for example Hammond, John S. III, "Better Decision with Preference Theory", Harvard Business Review, November-December 1967) toward the uncertainty in any decision and the managers attitude toward risk can lead to a situation where the manager

has much firmer base on which to base his intuition. One can then develop preference curves which can be used in conjunction with the decision makers expectations to evaluate the most profitable decision in a decision tree representation of his choice process.

This approach has been discussed extensively in the literature and has very obvious advantages. Its use has been severely limited in practical situations, due in part to the difficulty of collecting from the manager his assessment of probabilities. The manager in turn has had no way of knowing the company's attitude toward risk. Combining these problems of specifying risk, with the need for flexible structuring of the problem and the determination of the economic consequences of a decision, has been beyond the capabilities of the information systems we have had available. This situation is clearly changed with an MDS. It offers a mechanism by which the manager can interact with the system--develop his preference curves and test the outcome when he assigns various probabilities to the events involved.

This impact of the system is significant because uncertainty is always present in a business problem. The MDS offers a practical way of incorporating consistent management judgement about risk into the decision process. The technology is powerful enough to support the manager without his having to become an expert in the mathematics involved.

5. Joint Decision Process

The final impact of the MDS to be raised here is that of its direct effect on the communication process. Working with the display two or more managers can make their points using the light-pen and have the system respond. This allows them to pull out relevant data, or implement their suggestions as to strategy and immediately get a response. The implications of the suggestion are then apparent to all. Other managers can then call for further data or models to buttress their responses to the initial

suggestion. Such interactive use where the system is responding fast enough to match the decision maker's natural thinking speed is a different level of support then has been available from traditional MIS.

For example in a PERT/COST situation where the program manager and two of his major project managers are discussing performance to date and likely future problems. If one of the projects is in trouble, the manager involved could develop his strategy for its solution on the screen and have the network recalculated. His solution when implemented out over time may have implications for other aspects of the program. These can be identified then and there by the other managers involved and solutions developed for them. Such iterative, explicit, analysis provides at least three benefits.

1. By making the implications of the strategy clear it focuses discussion on known impacts, not on hypothesized impacts.

2. By showing the implications quickly the managers can all be present and can follow through on their strategies in one sitting.

3. If it is easy to test solutions, more solutions are likely to be tried, and the ones that are tried can be examined from the standpoints of each of the functions involved.

Working from the same set of facts, managers can spend their time discussing the intangibles and other issues that are not accounted for in the system. Such a joint process where all the managers that are involved can sit in one session has the advantage of bringing the relevant areas of expertise together at one point in time and combining their skills in the joint soltuion of a common problem. Focusing on the same issue, agreeing on the definition of the problem, all examining the implications of various solutions and each raising his view of these together with alternative suggestions--such a process can offer significant improvement over many current decision processes.

In the manufacturing situation raised earlier the use of such a system had three important changes.

a) The three managers involved were all present during the problem finding and problem solving process. Both the marketing and the production manager were able to bring their own specialized knowledge to bear, improving the quality and lowering the cost of the final decision. The decision process was speeded up, with the rapid response of the display, to the point where they felt it was useful to be present.

b) Looking at the historical performance and the future plans from several points of view, together with the comments from the different functional groups, provided a very clear picture of the situation. Such clarification focused the discussion much more directly on the relevant issues.

c) The commitment that arose from such clarification was significant. If any of the managers argued for <u>his</u> solution--in the face of the other data brought to the screen by one of the other managers--then his position was clear to all concerned. For example suppose the Sales Manager felt he could sell 100,000 units in the last quarter of the year. The production manager might not be able to make these without overtime, thus pushing up his costs. He might argue that the sales division could not sell that many. For support he could call onto the screen the sales for the same quarter in the previous three years, none of which showed sales of more than 75,000 units. If in the face of this evidence the sales manager still claimed he could make that objective then the might agree to go ahead. However his commitment was sharply focused and would not be forgotten by either the Division or Production Manager.

For these sorts of reasons the communication level between managers sizes sharply with the use of such a system. The improved communication seems to affect the quality of the final result and certainly improves the effectiveness of the managers involved in the decision process.

Conclusions

We have discussed five major kinds of impact that have been experienced with the use of a MDS--1) The clarification of issues, 2) The ability to deal with the future, 3) The use of models to support the decision process., 4) The capturing and explicit use of managerial judgment and 5) The use of joint decision sessions. The impacts occur partly because of technological changes, as evidenced by the hardware behind the MDS, and partly because of conceptual changes. The management decision system differs from traditional management information systems in several ways.

The MIS has often focused more on efficiency--reducing the cost of accomplishing some task. The MDS is primarily concerned with effectiveness--improving the decision process itself, not just providing the same information as before, only quicker. That is, MDS has as its primary purpose the support of a key decision

The MIS is often mostly concerned with information for functions (marketing, production, etc.) of the business. The MDS involves access to models for filtering information and providing computational power as well as flexible access to the information.

These systems are both useful, but each for their own purpose. It seems important to recognize the differences, if effective use is to be made of each. Line management cannot get much help in making key decisions for many aspects of the program management task from a traditional MIS. Its inflexibility, slow response and awkwardness of use combine to restrict

its use to fairly structured tasks. A MDS has the characteristics that allow it to be used for unstructured managerial decision situations.

It is being asserted that the MDS approach can be used on problems facing high level managers. That is, they can be used on ill-structured problems where there are trade-offs to be made, for example, between cost, schedule, technical performance and risk. To have an impact in such a situation the system should have fast response, a graphic capability and be designed with software to support the managers' natural decision processes.

Second generation batch computer systems cannot effectively support such a system, but many of the third generation systems can. Computational power alone is not the limitation. Clearly, for example, many PERT/COST planning and control systems are running on a batch system. However many of such systems, once they have been created, are awkward to use and to change. Managers use them, but mainly for structured tasks or routine reports. In some systems there has been concrete evidence of managers ignoring the computer based PERT system because of excessive rigidity, slow response and unusable reams of paper.

This is not to gainsay the usefulness of a PERT system run on a batch computer for the initial planning of the project or for solving structured problems. In addition, as operational support for many of the staff the system has and will continue to be most useful. What is being asserted is that planning and control techniques become even more useful when provided through a system such as the MDS which puts the senior line manager in direct contact with the models and information. In unstructured situations this becomes important as he can use his judgment to ask for and evaluate whatever information he feels is relevant. This ability to probe, follow through on hunches and build one's own structure to analyze the problem is a key element of a successful tool for problem solving at this level in the organization.

The point made by Galbraith in his paper would seem to be entirely correct--information can be used to buy some slack in the process of achieving the organizations goal. Perhaps the most significant way of achieving this is to use a system that provides access to more, relevant, information as well as access to models and computational power. In other words there is an upper limit to the slack that can be 'bought' with the use of more information of the sort that comes from 'traditional' information systems. However if we can filter this, and augment the managers' skills with relevant models then we have the possibility of orders of magnitude increases in the slack resources we free up. The clever combination of the manager and the MDS can improve the program management process way beyond that available with our current systems.